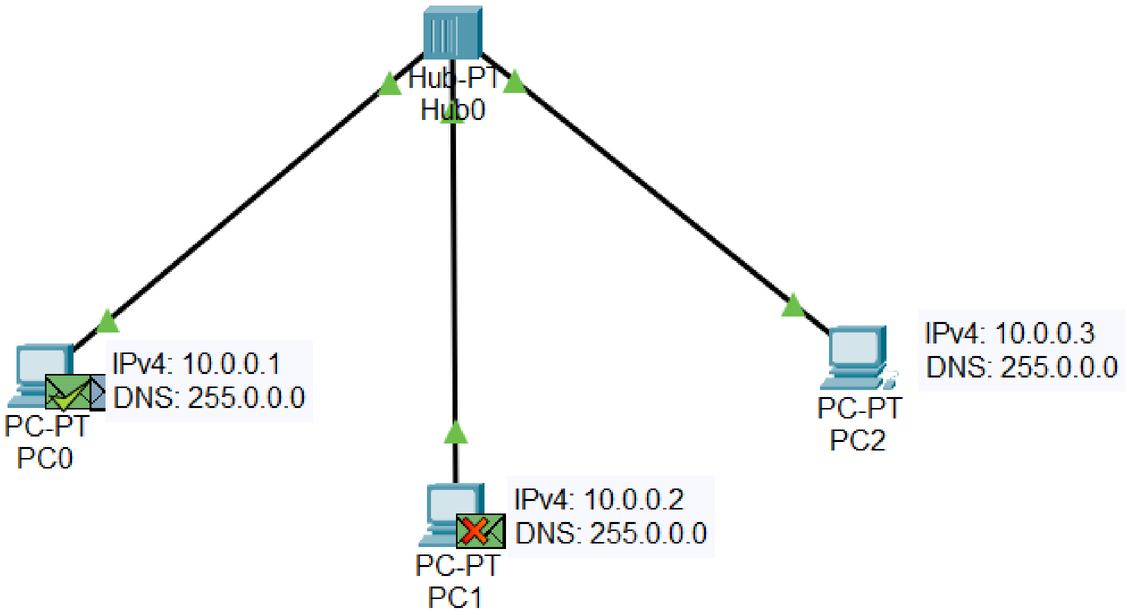
COMPUTER NETWORKS

LABORATORY PROGRAM – 1

Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message.

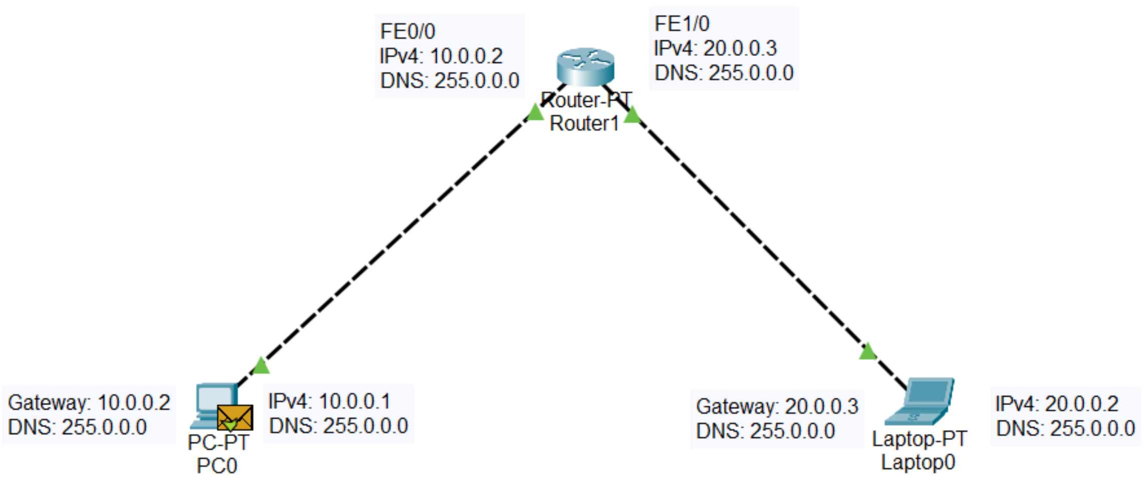


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC2	ICMP		0.000	N	0	(edit)	

```
C:\>ping 10.0.0.3

Pinging 10.0.0.3 with 32 bytes of data:

Reply from 10.0.0.3: bytes=32 time=9ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time=1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 2ms
```

LABORATORY PROGRAM – 2

Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.

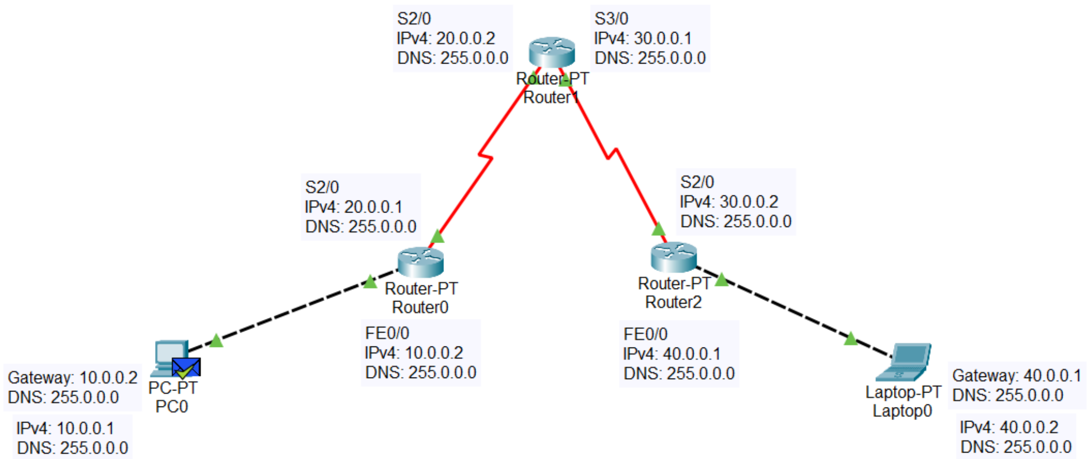


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	
	In Progress	PC0	Laptop0	ICMP		0.000	N	1	(edit)	
	In Progress	PC0	Laptop0	ICMP		0.000	N	2	(edit)	

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 20.0.0.3

Pinging 20.0.0.3 with 32 bytes of data:

Reply from 20.0.0.3: bytes=32 time<1ms TTL=255
Reply from 20.0.0.3: bytes=32 time<1ms TTL=255
Reply from 20.0.0.3: bytes=32 time<1ms TTL=255
Reply from 20.0.0.3: bytes=32 time<1ms TTL=255

Ping statistics for 20.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

LABORATORY PROGRAM – 3

Configure static route to the Router.



SHOW IP ROUTE

```
C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    20.0.0.0/8 is directly connected, Serial2/0
S    30.0.0.0/8 [1/0] via 20.0.0.2
S    40.0.0.0/8 [1/0] via 20.0.0.2
```

Figure 3.1: Router0

```
S    10.0.0.0/8 [1/0] via 20.0.0.1
C    20.0.0.0/8 is directly connected, Serial2/0
C    30.0.0.0/8 is directly connected, Serial3/0
S    40.0.0.0/8 [1/0] via 30.0.0.2
```

Figure 3.2: Router1

```
S    10.0.0.0/8 [1/0] via 30.0.0.1
S    20.0.0.0/8 [1/0] via 30.0.0.1
C    30.0.0.0/8 is directly connected, Serial2/0
C    40.0.0.0/8 is directly connected, FastEthernet0/0
```

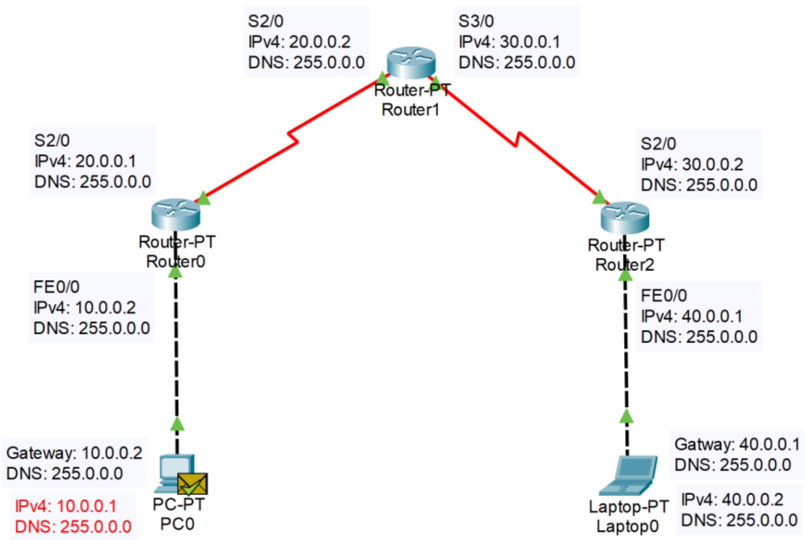
Figure 3.3: Router3.3

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 40.0.0.2

Pinging 40.0.0.2 with 32 bytes of data:

Reply from 40.0.0.2: bytes=32 time=36ms TTL=125
Reply from 40.0.0.2: bytes=32 time=34ms TTL=125
Reply from 40.0.0.2: bytes=32 time=30ms TTL=125
Reply from 40.0.0.2: bytes=32 time=26ms TTL=125

Ping statistics for 40.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 26ms, Maximum = 36ms, Average = 31ms
```

LABORATORY PROGRAM – 4(A)

Configure default route, static route to the Router.



SHOW IP ROUTE

```
Gateway of last resort is 20.0.0.2 to network 0.0.0.0

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    20.0.0.0/8 is directly connected, Serial2/0
S*   0.0.0.0/0 [1/0] via 20.0.0.2
```

Figure 4.1: Router0

```
S    10.0.0.0/8 [1/0] via 20.0.0.1
C    20.0.0.0/8 is directly connected, Serial2/0
C    30.0.0.0/8 is directly connected, Serial3/0
S    40.0.0.0/8 [1/0] via 30.0.0.2
```

Figure4.2: Router1

```
Gateway of last resort is 30.0.0.1 to network 0.0.0.0

C    30.0.0.0/8 is directly connected, Serial2/0
C    40.0.0.0/8 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 30.0.0.1
```

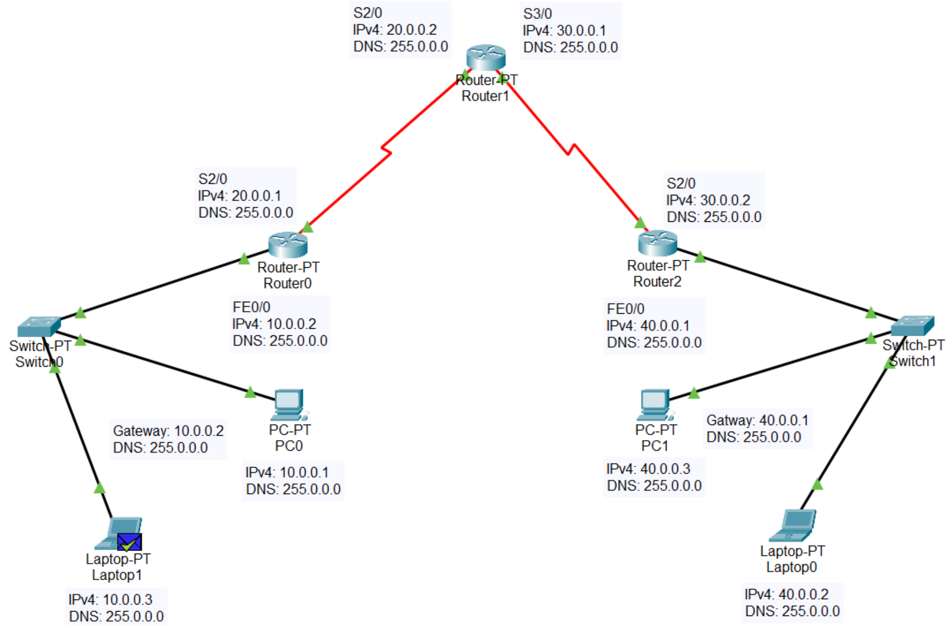
Figure 4.3: Router2

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	

```
C:\>ping 40.0.0.2

Pinging 40.0.0.2 with 32 bytes of data:

Reply from 40.0.0.2: bytes=32 time=34ms TTL=125
Reply from 40.0.0.2: bytes=32 time=33ms TTL=125
Reply from 40.0.0.2: bytes=32 time=30ms TTL=125
Reply from 40.0.0.2: bytes=32 time=33ms TTL=125

Ping statistics for 40.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 30ms, Maximum = 34ms, Average = 32ms
```

LABORATORY PROGRAM – 4(B)

Configure default route, static route to the Router, inclusive switches.



SHOW IP ROUTE

```
Gateway of last resort is 20.0.0.2 to network 0.0.0.0

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    20.0.0.0/8 is directly connected, Serial2/0
S*   0.0.0.0/0 [1/0] via 20.0.0.2
```

Figure 4.1: Router0

```
S    10.0.0.0/8 [1/0] via 20.0.0.1
C    20.0.0.0/8 is directly connected, Serial2/0
C    30.0.0.0/8 is directly connected, Serial3/0
S    40.0.0.0/8 [1/0] via 30.0.0.2
```

Figure4.2: Router1

```
Gateway of last resort is 30.0.0.1 to network 0.0.0.0

C    30.0.0.0/8 is directly connected, Serial2/0
C    40.0.0.0/8 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 30.0.0.1
```

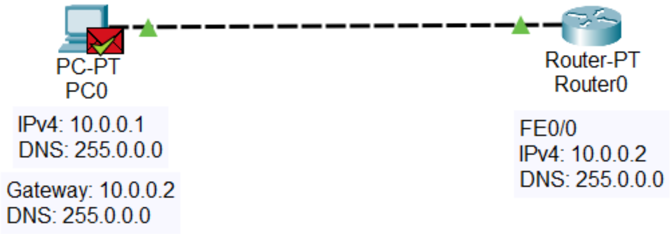
Figure 4.3: Router2

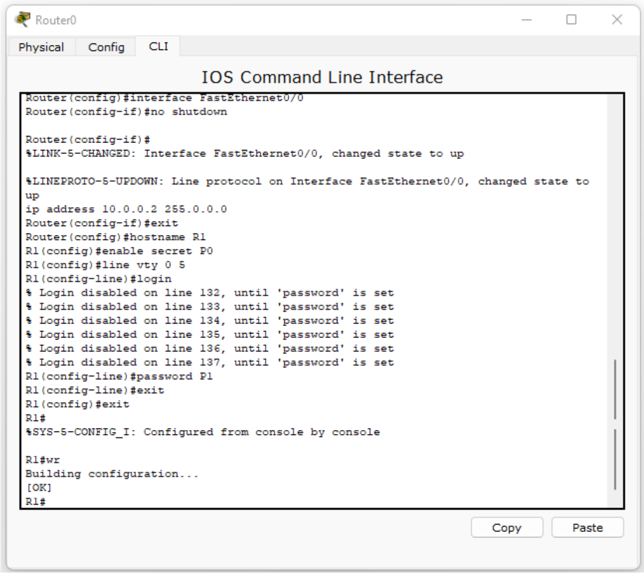
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	

```
C:\>ping 40.0.0.3

Pinging 40.0.0.3 with 32 bytes of data:

Reply from 40.0.0.3: bytes=32 time=35ms TTL=125
Reply from 40.0.0.3: bytes=32 time=37ms TTL=125
Reply from 40.0.0.3: bytes=32 time=24ms TTL=125
Reply from 40.0.0.3: bytes=32 time=38ms TTL=125

Ping statistics for 40.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 24ms, Maximum = 38ms, Average = 33ms
```

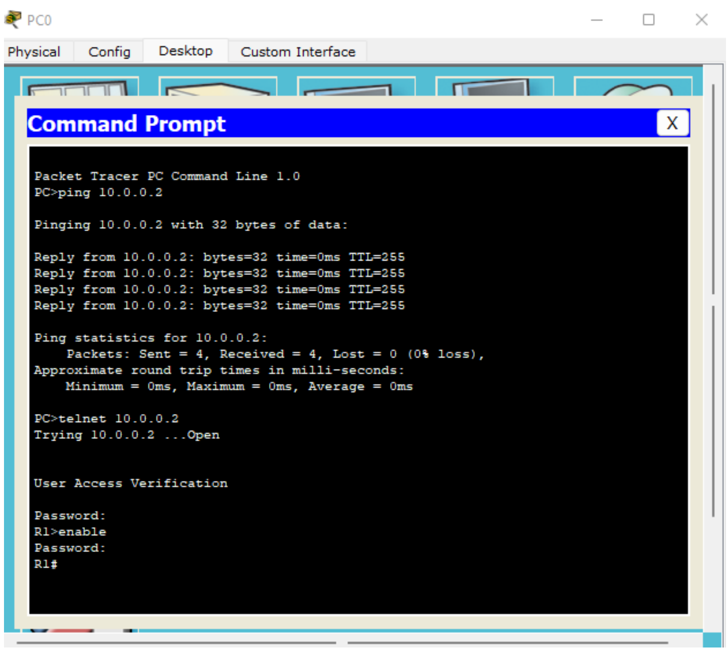
LABORATORY PROGRAM – 5

To understand the operation of TELNET by accessing the router in server room from a PC in IT office.



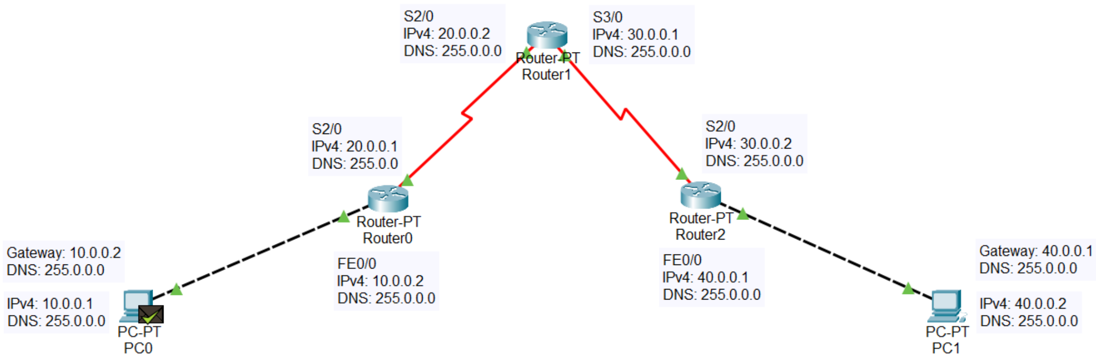


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Router0	ICMP		0.000	N	0	(edit)	



LABORATORY PROGRAM – 6

Demonstrate the TTL/ Life of a Packet.



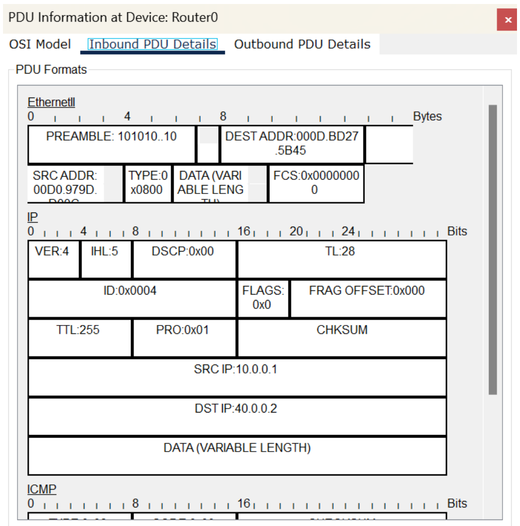


Figure 6.1: Inbound PDU, Router0

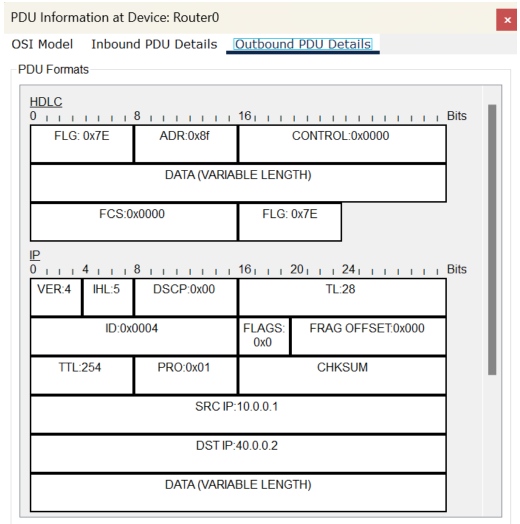


Figure 6.2: Outbound PDU, Router0

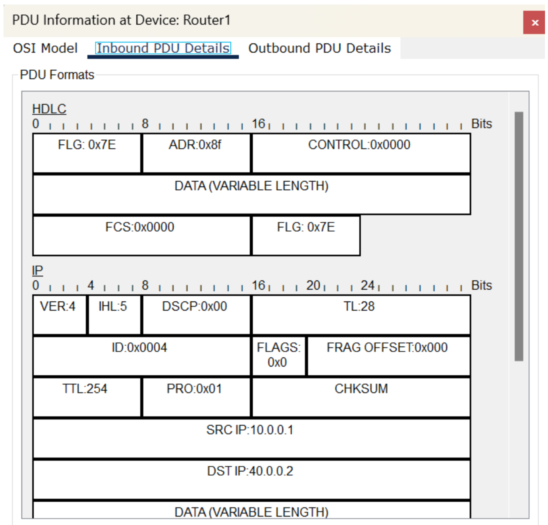


Figure 6.3: Inbound PDU, Router1

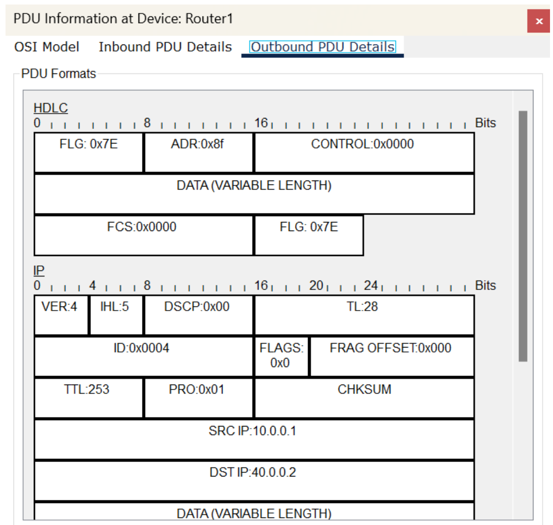


Figure 6.4: Outbound PDU, Router1

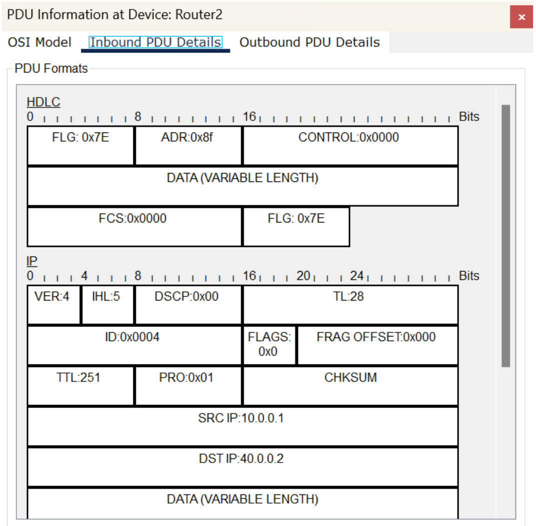


Figure 6.5: Inbound PDU, Router2

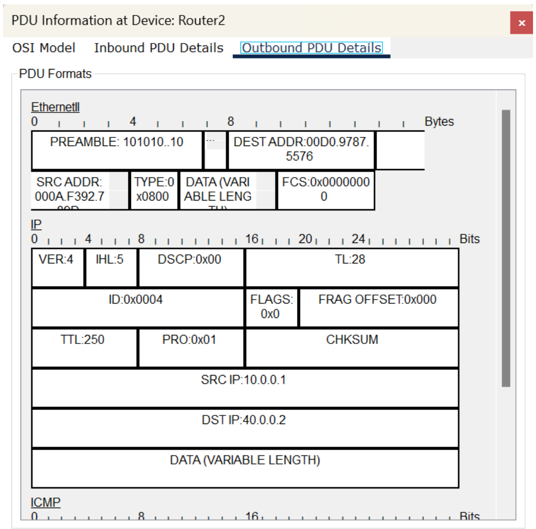


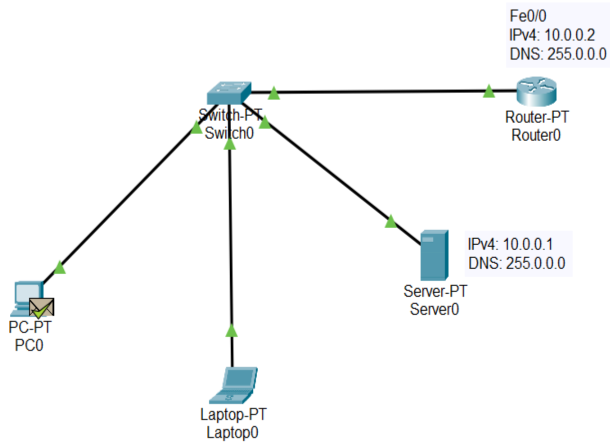
Figure 6.6: Outbound PDU, Router2

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC1	ICMP		0.000	N	0	(edit)	

```
C:\>ping 40.0.0.2

Pinging 40.0.0.2 with 32 bytes of data:

Reply from 40.0.0.2: bytes=32 time=72ms TTL=123
Reply from 40.0.0.2: bytes=32 time=53ms TTL=123
Reply from 40.0.0.2: bytes=32 time=55ms TTL=123
Reply from 40.0.0.2: bytes=32 time=69ms TTL=123

Ping statistics for 40.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 53ms, Maximum = 72ms, Average = 62ms
```

LABORATORY PROGRAM – 7(A)

To Configure IP addresses of the host using DHCP server within a LAN.



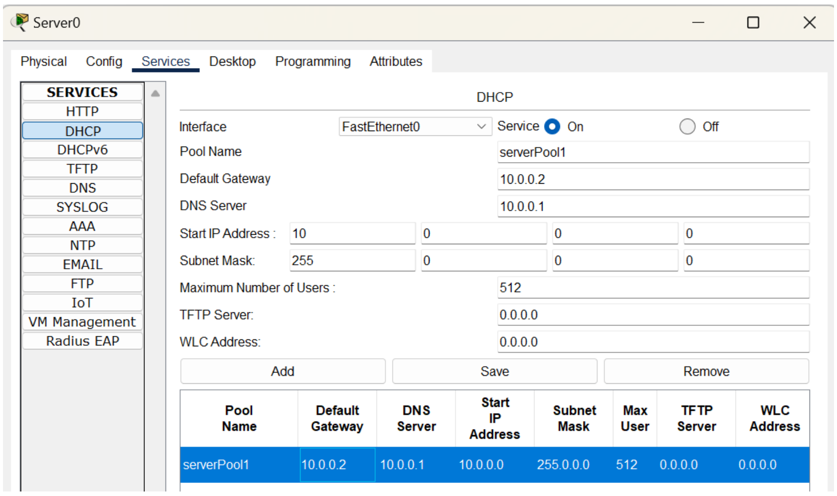


Figure 7.1: DHCP Service, Server0

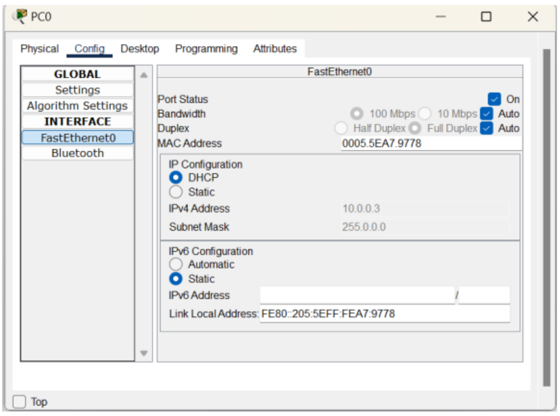


Figure 7.2: DHCP Service, PC0

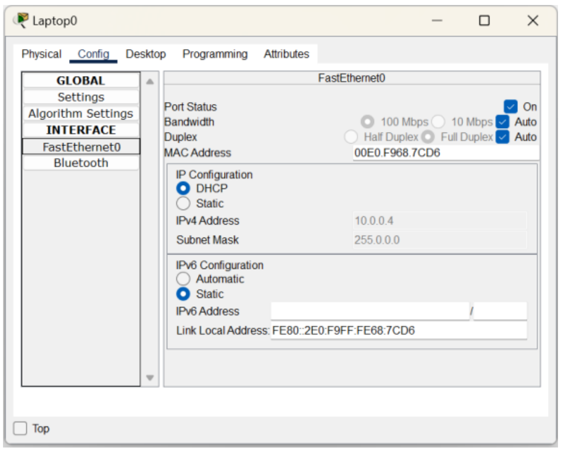
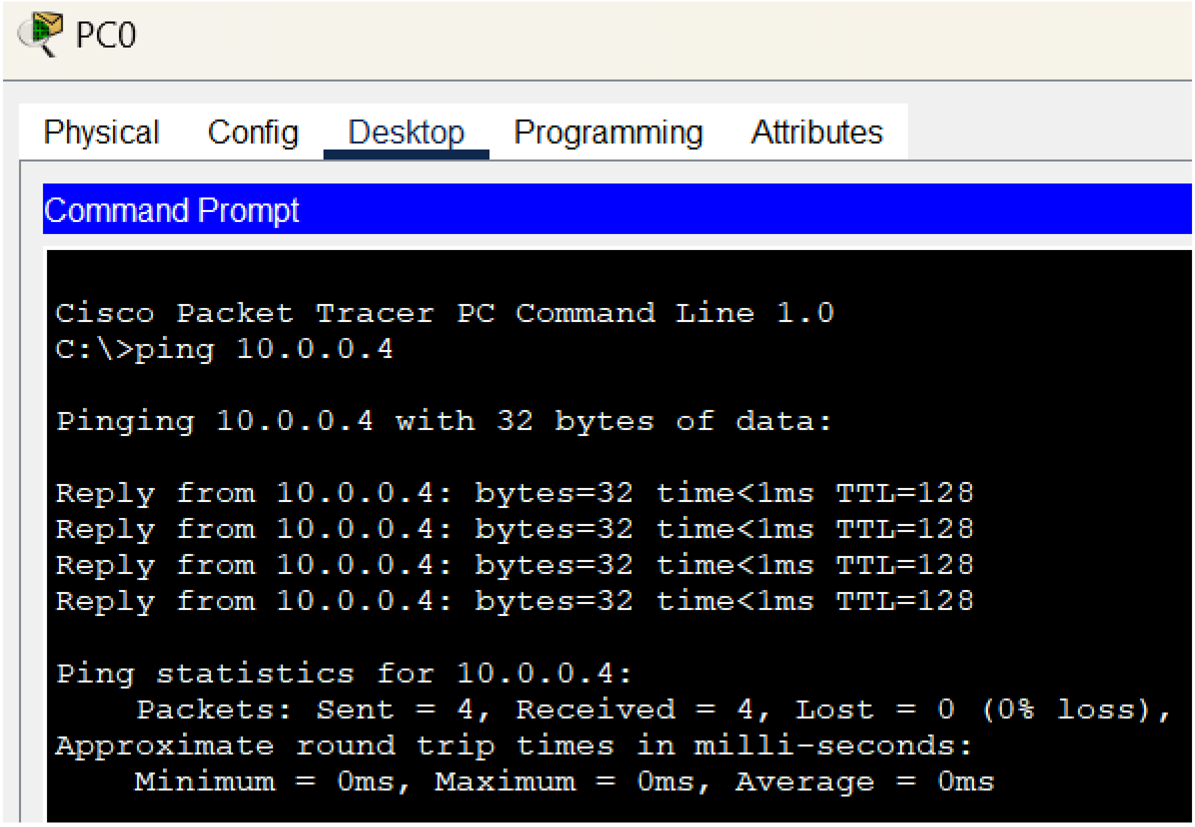


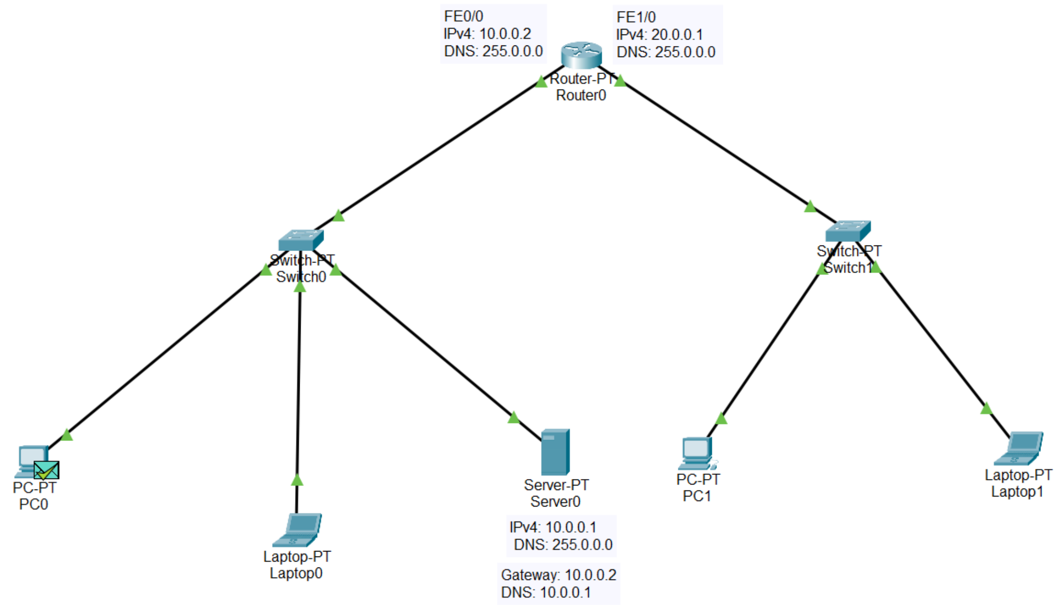
Figure 7.3: DHCP Service, Laptop0

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	



LABORATORY PROGRAM – 7(B)

To Configure IP addresses of the host using DHCP server outside a LAN.



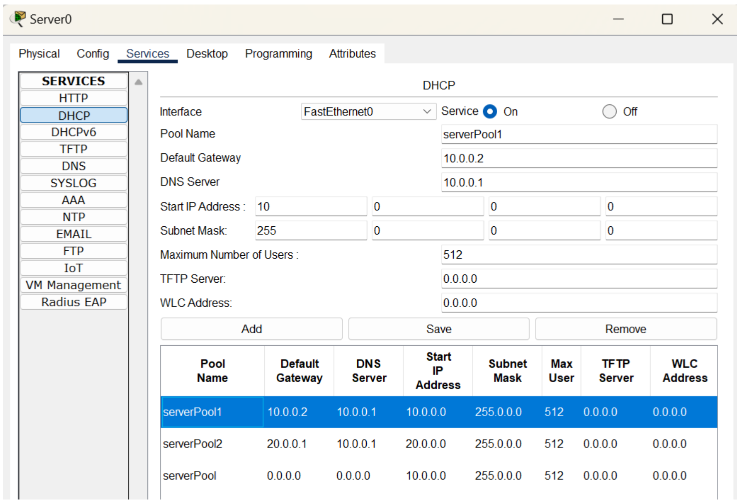


Figure 7.2.1: DHCP Service, Server0

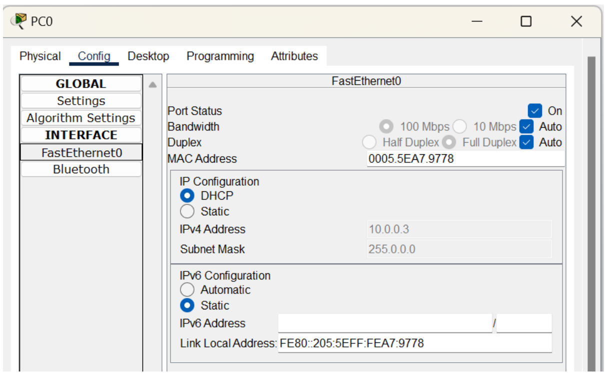


Figure7.2.2: DHCP Service, PC0

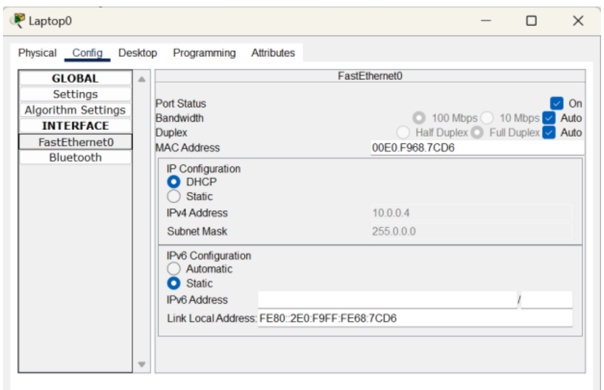


Figure 7.2.3: DHCP Service, Laptop0

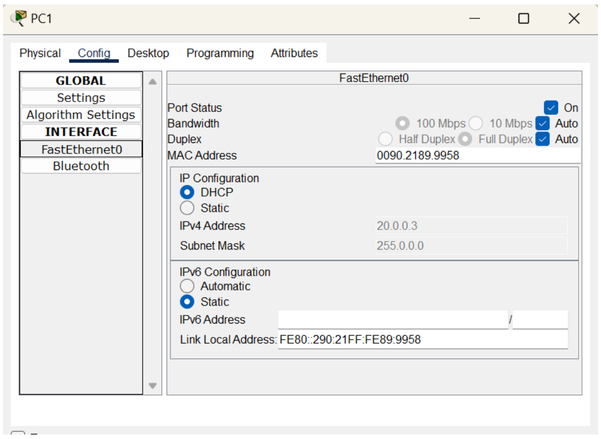


Figure 7.2.4: DHCP Service, PC1

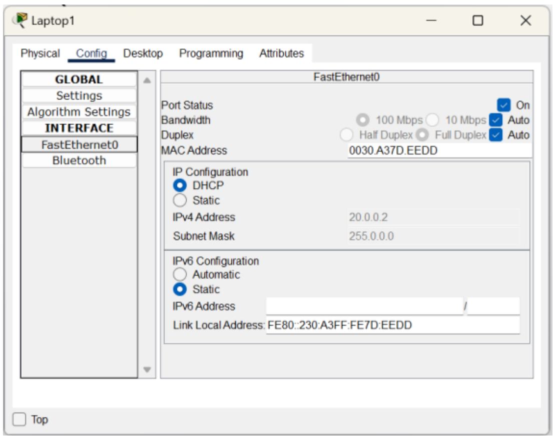
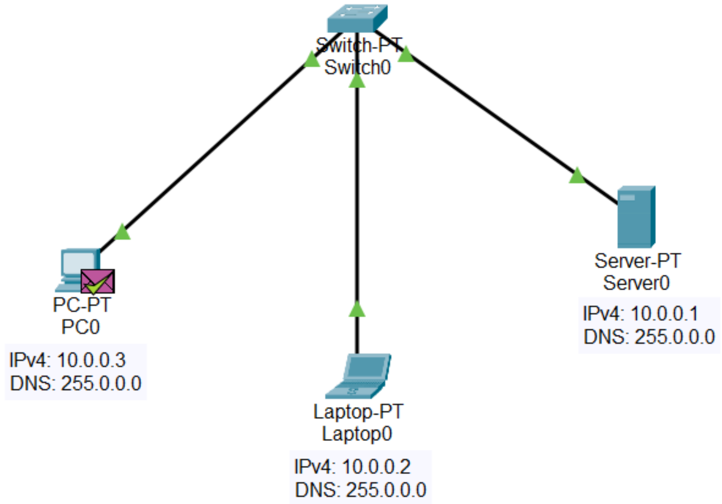


Figure 7.2.5: DHCP Service, Laptop1

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	
	Successful	PC1	Laptop1	ICMP		0.004	N	1	(edit)	

LABORATORY PROGRAM – 8

To Configure DNS server to demonstrate the mapping of IP addresses and Domain names.



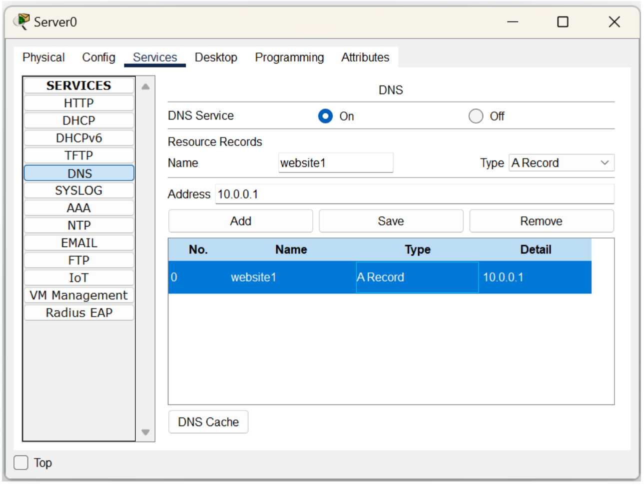


Figure 8.1: DNS Service, Server0

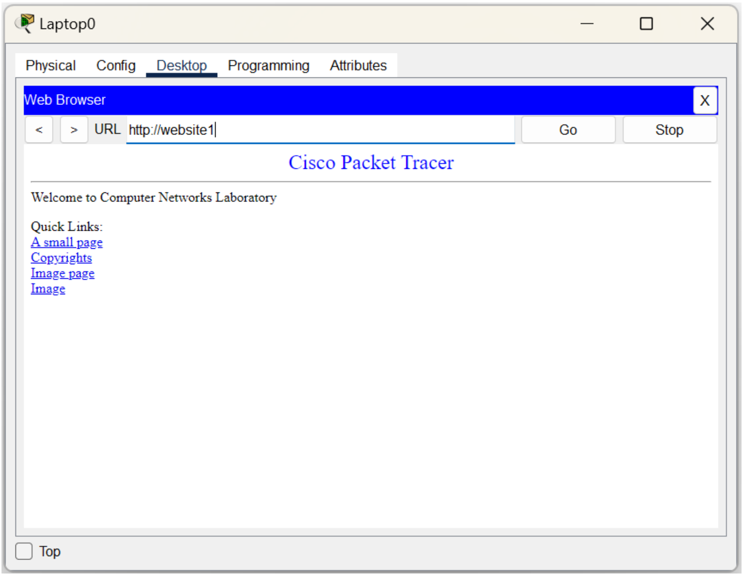
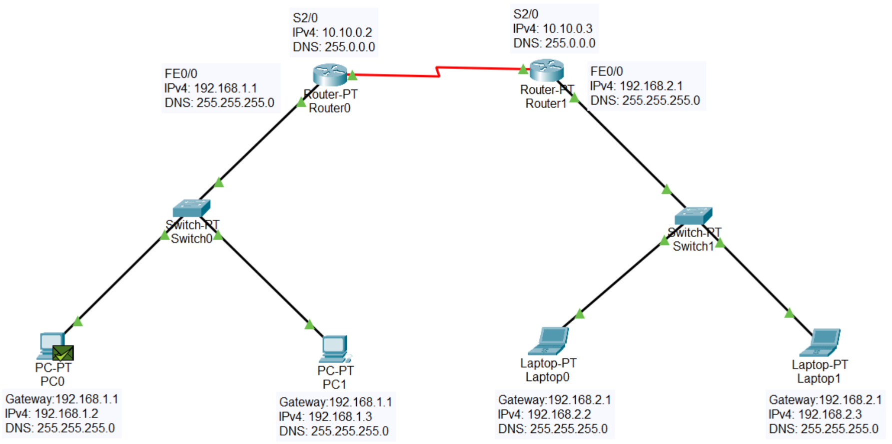


Figure 8.2: DNS Service, Laptop0

LABORATORY PROGRAM – 9

To Configure RIP routing protocol in Routers.



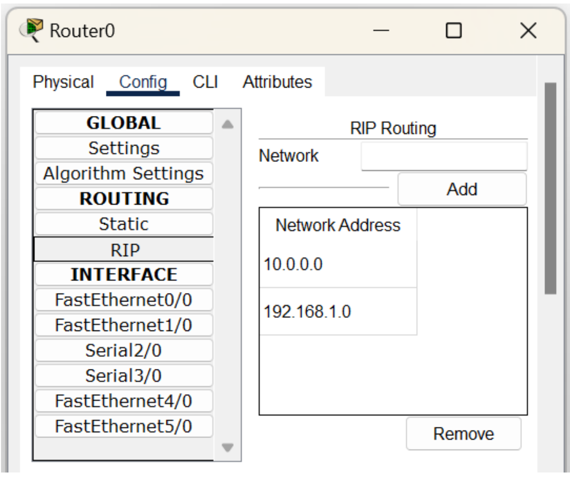


Figure 9.1: RIP, Router0

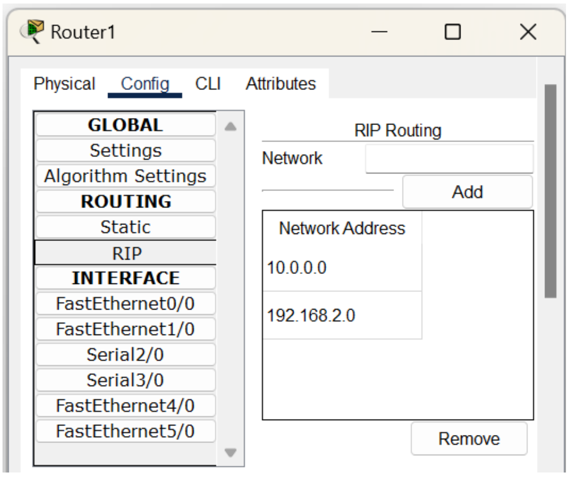


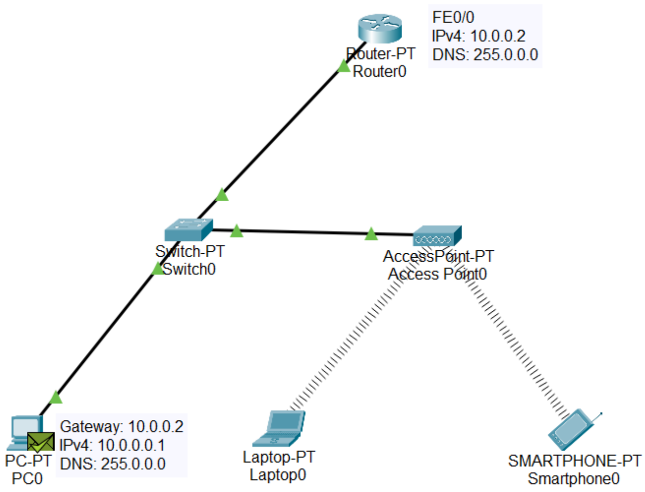
Figure 9.2: RIP, Router

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop1	ICMP		0.000	N	0	(edit)	

```
C:\>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:

Reply from 192.168.2.3: bytes=32 time=18ms TTL=126
Reply from 192.168.2.3: bytes=32 time=14ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 18ms, Average = 8ms
```

LABORATORY PROGRAM – 10

To demonstrate communication between two devices using a wireless LAN.



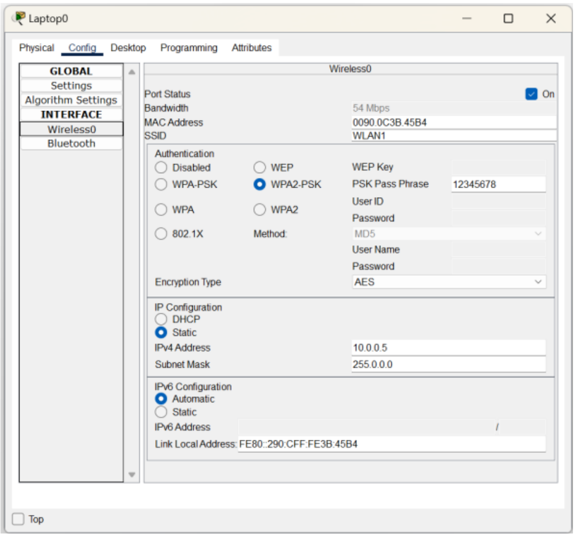


Figure 10.1: Laptop0, Wireless0

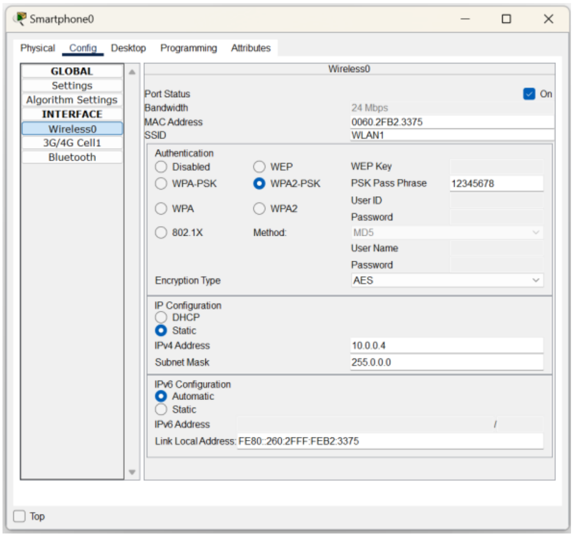
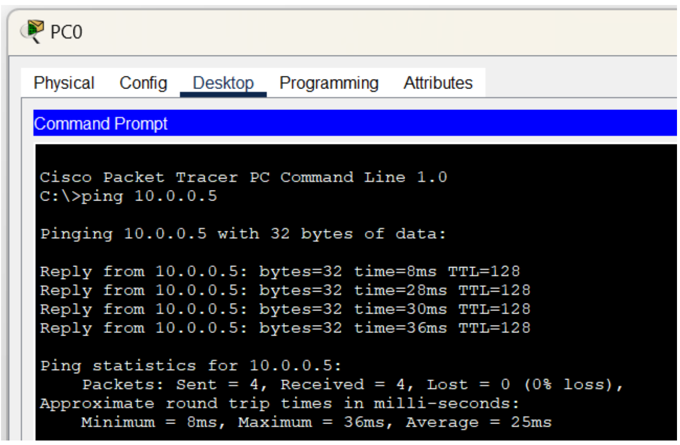


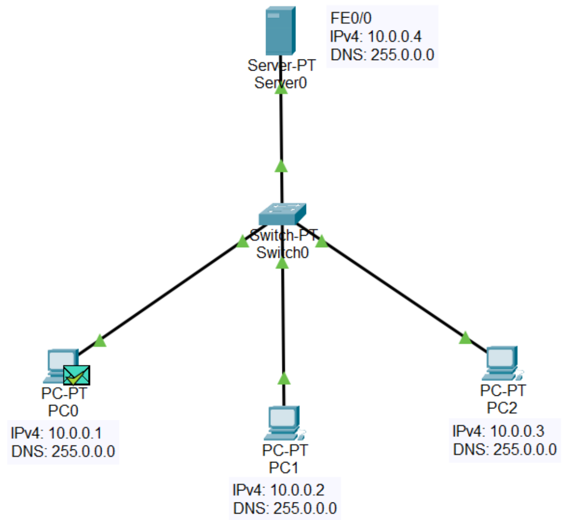
Figure 10.2: Smartphone0, Wireless0

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Laptop0	ICMP		0.000	N	0	(edit)	



LABORATORY PROGRAM – 11

To demonstrate the working of Address Resolution Protocol (ARP) within a LAN for communication.



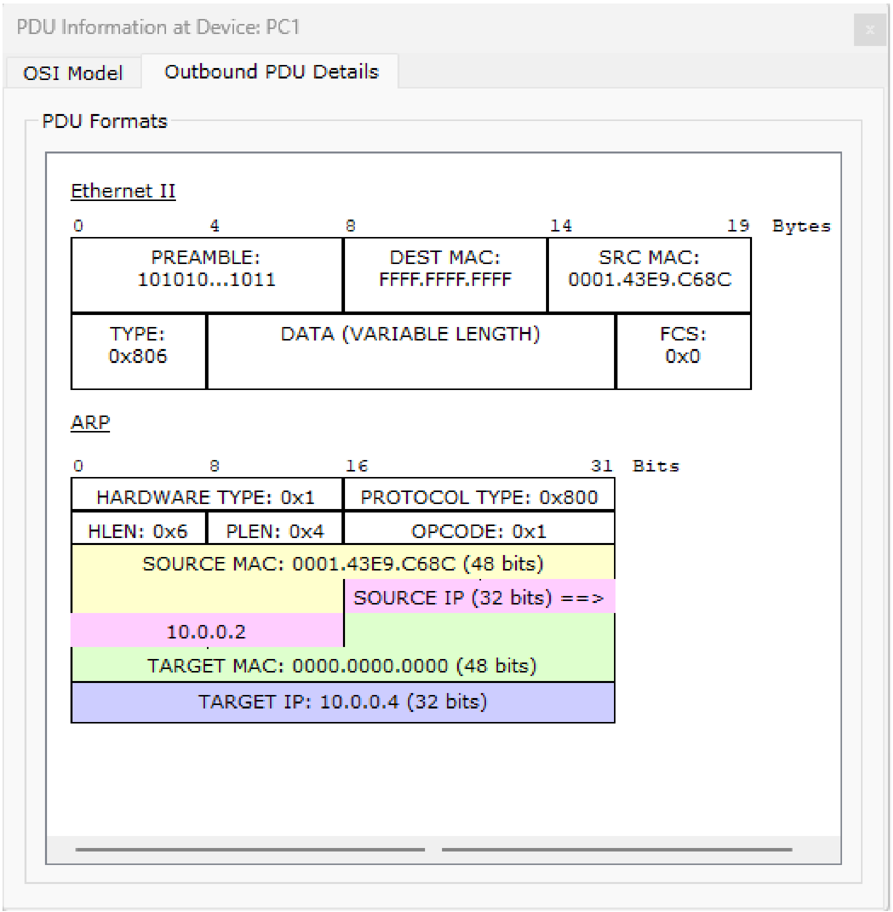


Figure 11.1: Inbound ARP, PC1

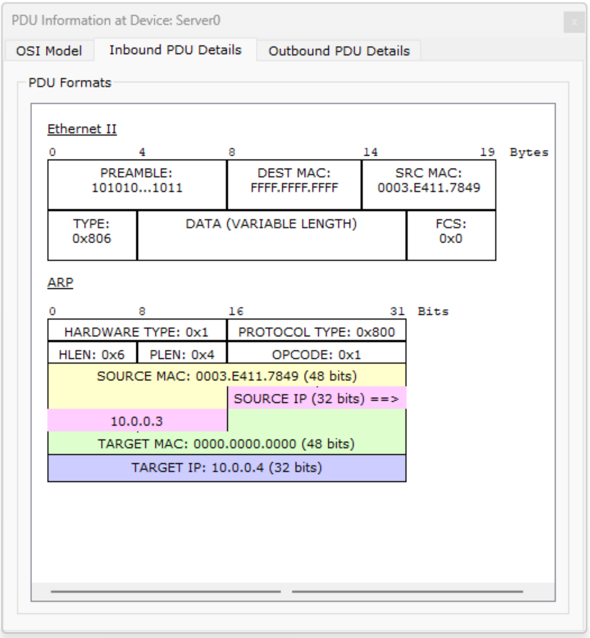


Figure 11.2: Inbound ARP, Server0

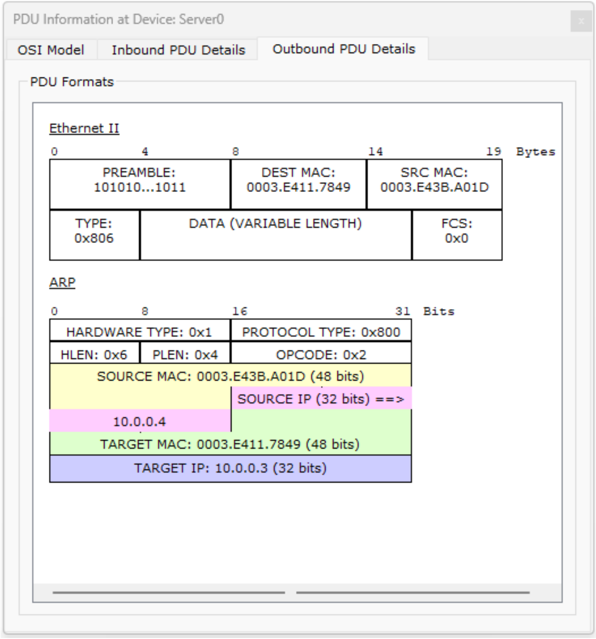
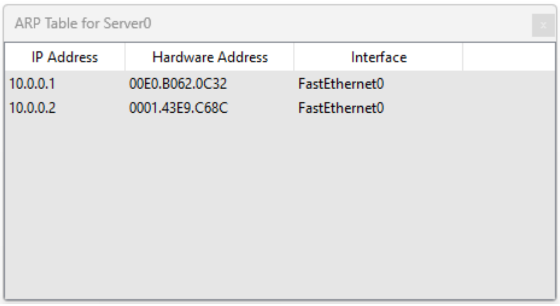


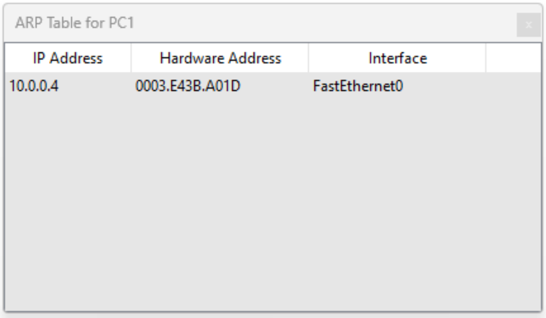
Figure 11.3: Outbound ARP, Server0



ARP Table for Server0

IP Address	Hardware Address	Interface
10.0.0.1	00E0.B062.0C32	FastEthernet0
10.0.0.2	0001.43E9.C68C	FastEthernet0

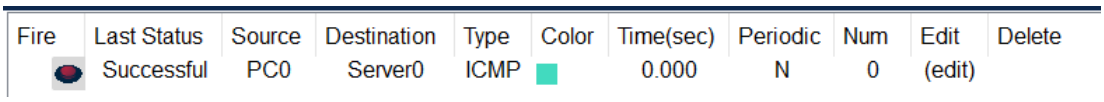
Figure 11.4: ARP Table, Server0



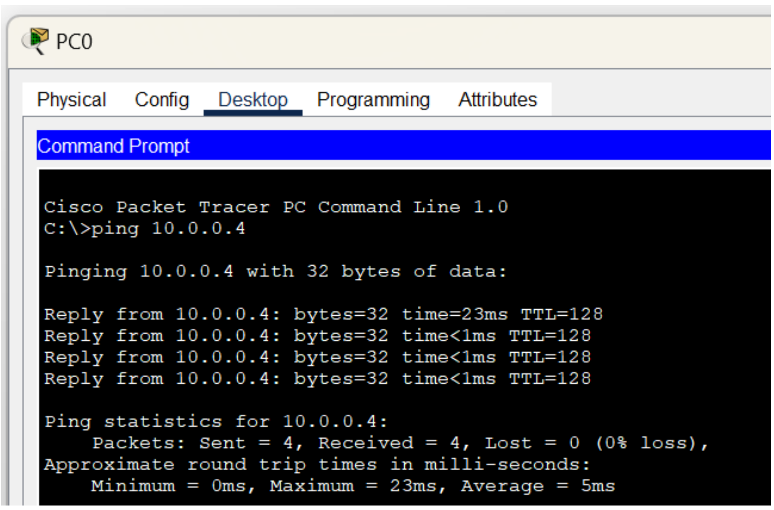
ARP Table for PC1

IP Address	Hardware Address	Interface
10.0.0.4	0003.E43B.A01D	FastEthernet0

Figure 11.5: ARP Table, PC1

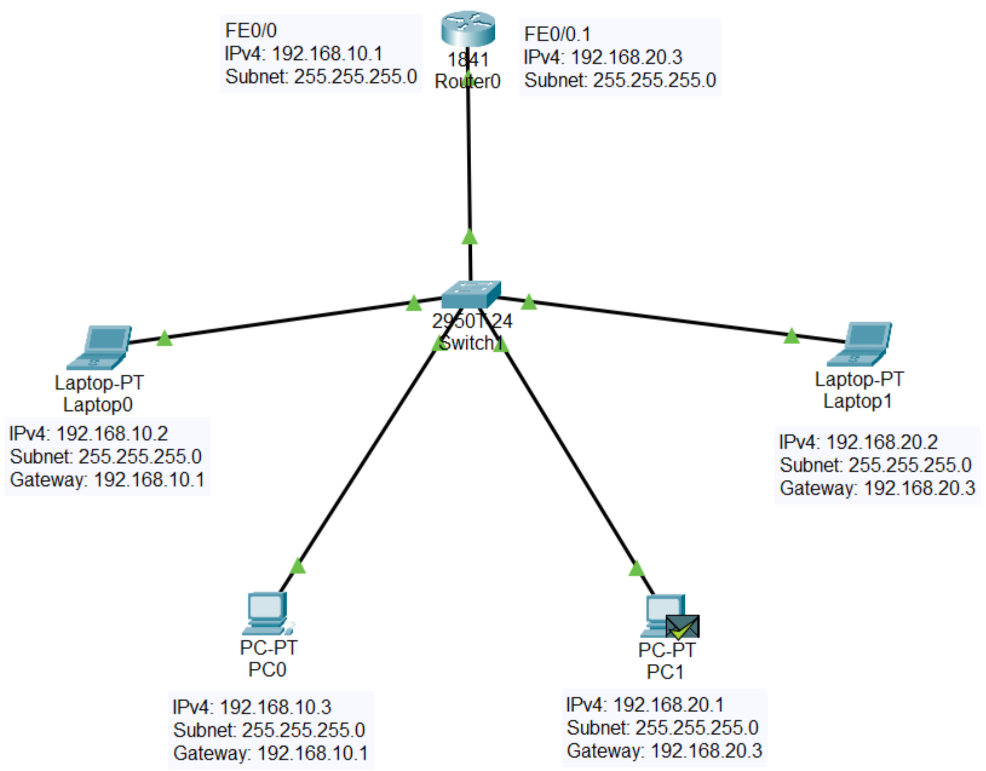


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	Server0	ICMP		0.000	N	0	(edit)	



LABORATORY PROGRAM – 12

To create a VLAN on top of the physical LAN and enable communication between physical LAN and virtual LAN.



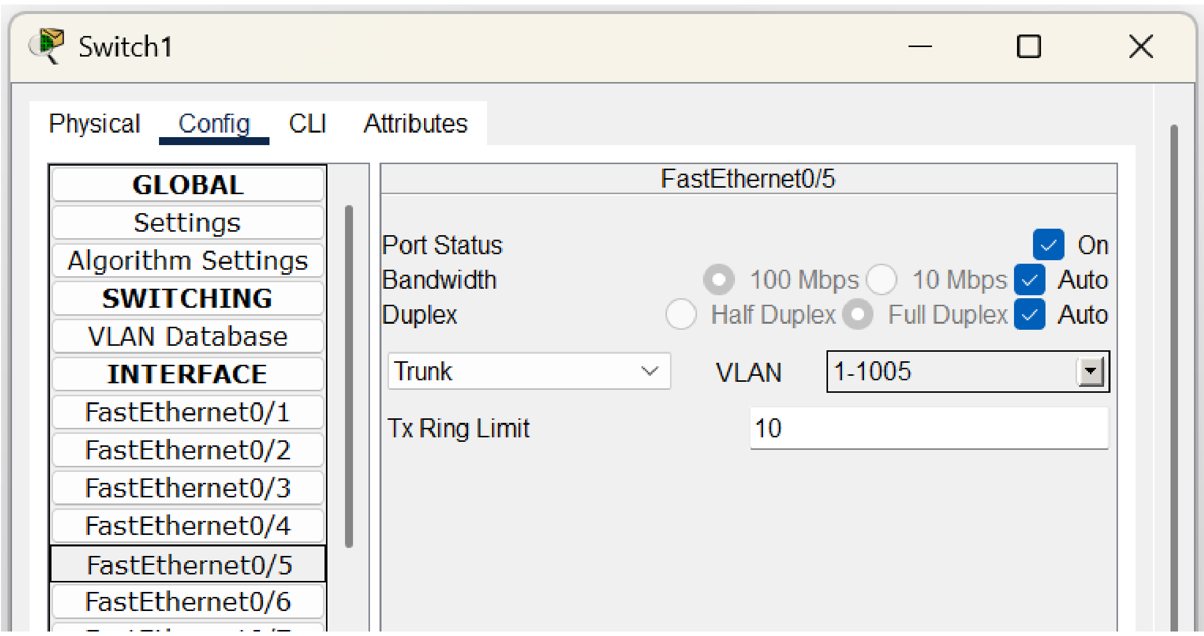


Figure 12.1: FE0/5 Switchport Trunk

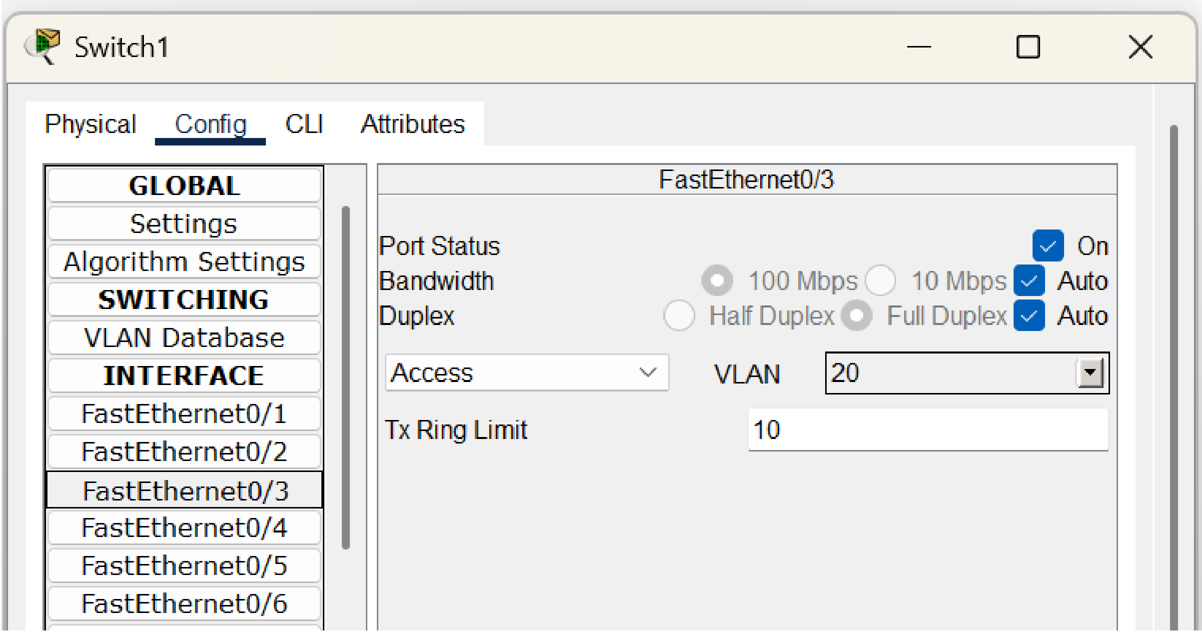


Figure 12.2: FE0/3 Switchport Access

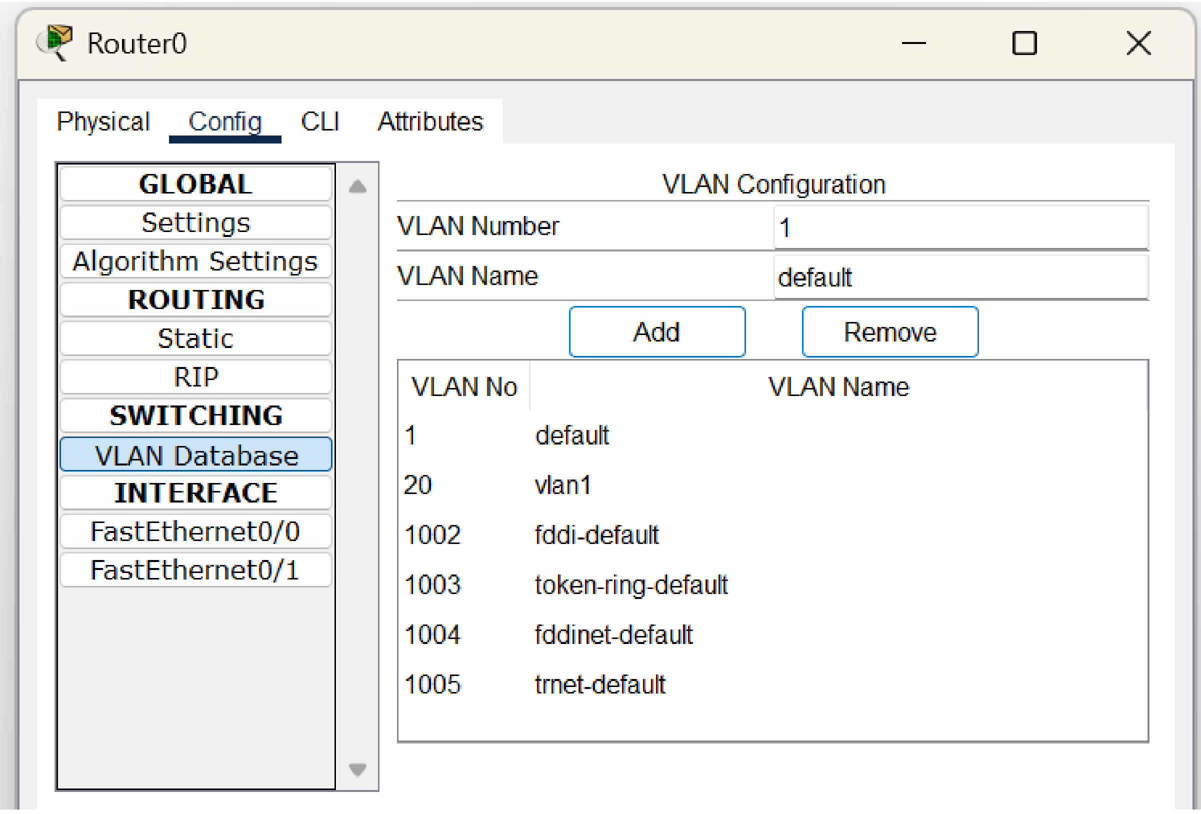


Figure 12.3: Router0 VLAN Database

```
Router(config)#interface FastEthernet0/0.1
Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 192.168.20.3 255.255.255.0
Router(config-subif)#no shutdown
```

Figure 3: Router0, FE0/0.1

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC1	Router0	ICMP		0.000	N	0	(edit)	

```
C:\>ping 192.168.20.3

Pinging 192.168.20.3 with 32 bytes of data:

Reply from 192.168.20.3: bytes=32 time=2ms TTL=255
Reply from 192.168.20.3: bytes=32 time<1ms TTL=255
Reply from 192.168.20.3: bytes=32 time<1ms TTL=255
Reply from 192.168.20.3: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

LABORATORY PROGRAM – 13

Write a program for error detecting code using CRC-CCITT (8-bits).

Code

```
def xor(dividend, divisor):
    """Perform XOR operation between dividend and divisor."""
    result = ''
    for i in range(1, len(divisor)):
        result += '0' if dividend[i] == divisor[i] else '1'
    return result


def crc(data, gen_poly):
    """Compute the CRC check value using CRC-CCITT (8-bit)."""
    data_length = len(data)
    gen_length = len(gen_poly)

    # Append n-1 zeros to the data
    padded_data = data + '0' * (gen_length - 1)
    check_value = padded_data[:gen_length]

    for i in range(data_length):
        if check_value[0] == '1':
            # XOR operation if the first bit is 1
            check_value = xor(check_value, gen_poly)
        else:
            # Retain original check value if first bit is 0
            check_value = check_value[1:]

        # Shift left and add the next data bit
        if i + gen_length < len(padded_data):
            check_value += padded_data[i + gen_length]

    return check_value[1:]  # Remove the leading bit


def receiver(data, gen_poly):
    """Simulate the receiver side to check for errors."""
    print("\n----------------------------")
    print("Data received:", data)

    # Perform CRC computation on received data
    remainder = crc(data, gen_poly)

    # Check if the remainder is all zeros
    if '1' in remainder:
        print("Error detected")
    else:
        print("No error detected")


if __name__ == "__main__":
    # Input data and generator polynomial
    data = input("Enter data to be transmitted: ")
    gen_poly = input("Enter the Generating polynomial: ")
```

```
    # Compute CRC check value
    check_value = crc(data, gen_poly)
    print("\n---------------------------------------")
    print("Data padded with n-1 zeros:", data + '0' * (len(gen_poly) - 1))
    print("CRC or Check value is:", check_value)

    # Append check value to data for transmission
    transmitted_data = data + check_value
    print("Final data to be sent:", transmitted_data)
    print("---------------------------------------\n")

    # Simulate the receiver side
    received_data = input("Enter the received data: ")
    receiver(received_data, gen_poly)
```

Output

```
Enter data to be transmitted: 1001100
Enter the Generating polynomial: 100001011

----------------------------------------
Data padded with n-1 zeros: 1001100000000000
CRC or Check value is: 0100010
Final data to be sent: 10011000100010
----------------------------------------

Enter the received data: 10011000100011

-----------------------------
Data received: 10011000100011
Error detected
```

LABORATORY PROGRAM – 14

Write a program for congestion control using Leaky bucket algorithm.

Code

```
# Getting user inputs
storage = int(input("Enter initial packets in the bucket: "))
no_of_queries = int(input("Enter total no. of times bucket content is checked: "))
bucket_size = int(input("Enter total no. of packets that can be accommodated in the bucket: "))
input_pkt_size = int(input("Enter no. of packets that enters the bucket at a time: "))
output_pkt_size = int(input("Enter no. of packets that exits the bucket at a time: "))

for i in range(no_of_queries):  # space left
    size_left = bucket_size - storage
    if input_pkt_size <= size_left:
        # update storage
        storage += input_pkt_size
    else:
        print("Packet loss =", input_pkt_size)

    print(f"Buffer size = {storage} out of bucket size = {bucket_size}")

    # as packets are sent out into the network, the size of the storage decreases
    storage -= output_pkt_size
```

Output

```
Enter initial packets in the bucket: 0
Enter total no. of times bucket content is checked: 4
Enter total no. of packets that can be accommodated in the bucket: 10
Enter no. of packets that enters the bucket at a time: 4
Enter no. of packets that exits the bucket at a time: 1
Buffer size = 4 out of bucket size = 10
Buffer size = 7 out of bucket size = 10
Buffer size = 10 out of bucket size = 10
Packet loss = 4
Buffer size = 9 out of bucket size = 10
```